Concrete Masonry
CONSTRUCTION DETAILS

Prepared by

NATIONAL CONCRETE MASONRY ASSOCIATION

38 SOUTH DEARBORN STREET • CHICAGO 3, ILLINOIS

THE following details have been prepared by the National Concrete Masonry Association to acquaint advanced students of architecture in the matter of approved concrete masonry design. These should also prove helpful to the practicing architect or builder. Strict attention has been given to the requirements of the American Society for Testing Materials and the Federal Government in the preparation of these details.

The National Concrete Masonry Association is a non-profit promotional and technical organization, comprised of manufacturers of quality concrete masonry units in the United States and Canada. Its objects are: (1) to facilitate the acquirement and interchange of practical knowledge among its members; (2) to encourage the development of the art of manufacturing concrete masonry units; (3) to create a standard of excellence in manufacture; (4) to promote the use of concrete masonry; (5) to arrange and provide for advertising the products of members; (6) to gather data and issue literature of technical as well as promotive character; (7) to exercise a corrective influence on the quality of concrete masonry units to the end that Association standards may be maintained; and (8) to secure more efficient cooperation between the concrete masonry industry and architects, builders, building officials, engineers, owners and others. The complete N. C. M. A. roster will be sent upon request.

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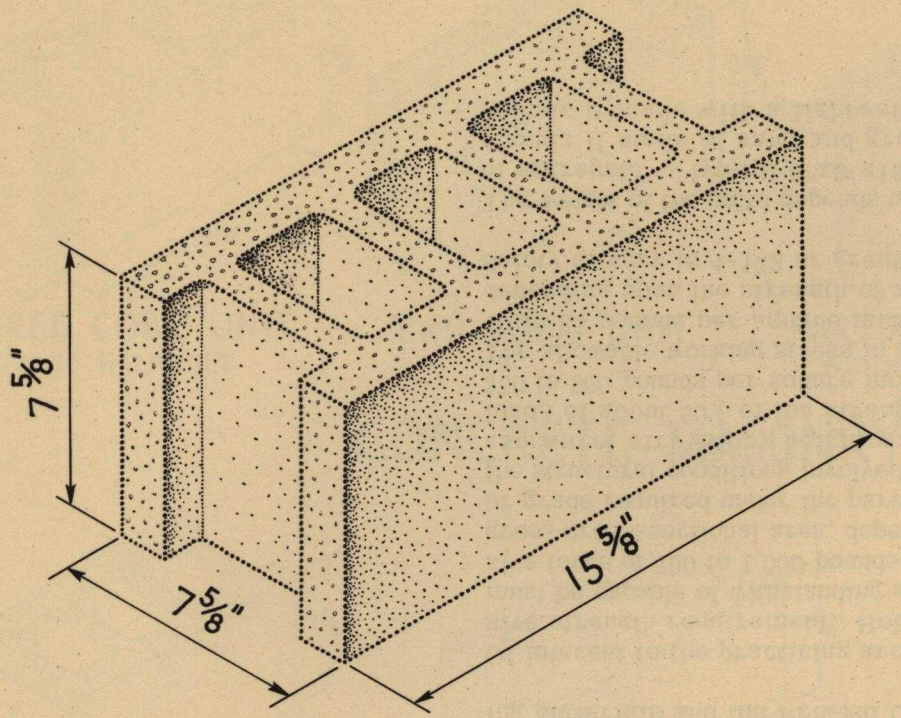
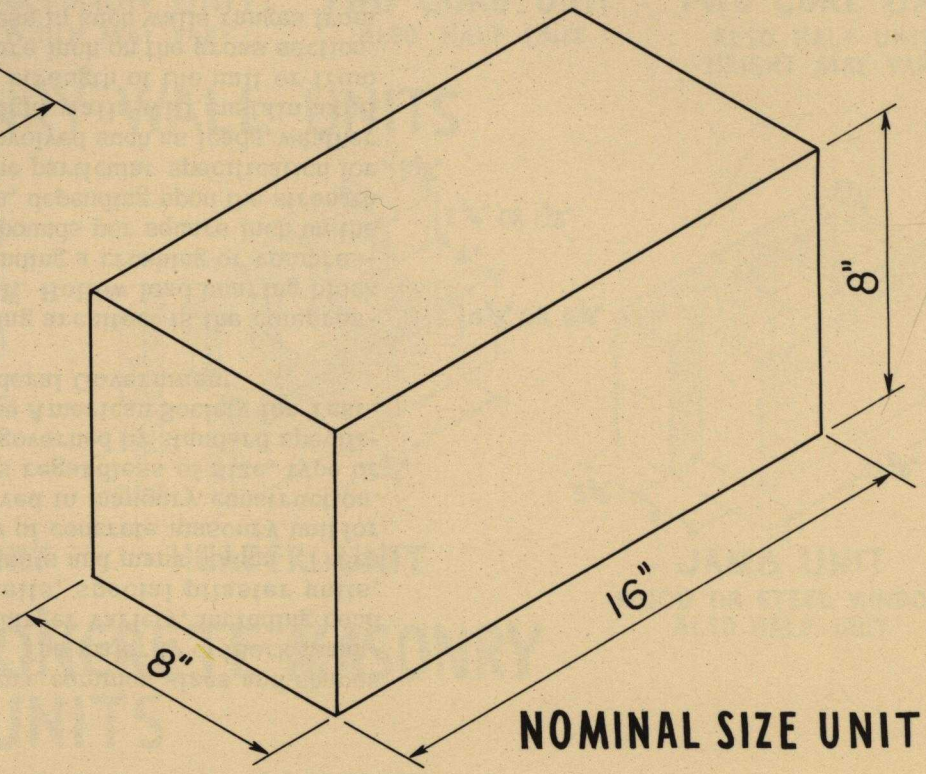
Concrete masonry units include solid and hollow block of relatively large size and also concrete brick. Concrete masonry units are made from a mixture of portland cement, water and various kinds of aggregates, such as sand and gravel, crushed stone, steam boiler cinders, blast furnace slag, expanded burned clay or shale, pumice and scoria. It is advisable to determine the types of aggregates available before specifying block for a job.

The 8"x8"x16" nominal size unit is one of the most commonly used sizes. About 65% to 75% of all concrete masonry units used are modular in size. In other words, the actual dimensions -- thickness, height and length -- are 3/8" less than nominal dimensions. This allows for standard 3/8" mortar joint. Where concrete masonry is laid out according to modular system using the 8" module, there are 2 resulting benefits -- not only is there a saving in mason labor, but also the wall has a more attractive appearance. This results from eliminating most, if not all, cutting of units on the job which is an expensive operation.



ACTUAL SIZE MODULAR CONCRETE MASONRY UNIT

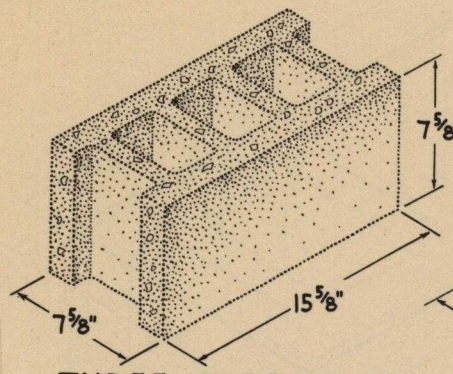


NOMINAL SIZE UNIT

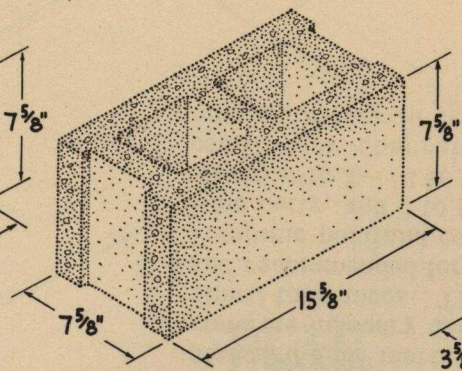
These are a few of the more common sizes and shapes of concrete masonry units. The majority of block manufacturers furnish a much larger variety, including bond beam lintel units, sill units, special pilaster units, chimney block, bull-nose units and many others. There is, in fact, a type and size of concrete masonry unit for almost every detail involved in masonry construction. The quality of these units regardless of size, type or kind of aggregate used is governed by standard specifications such as those of the American Society for Testing Materials and the Federal Government.

Of interest to the practicing architect is the compressive strength requirement. Hollow load bearing block must be capable of withstanding a crushing or compressive force of 700 to 1,000 pounds per square inch on the gross cross-sectional area, depending upon the strength or grade required under the particular specification for the structural conditions involved such as loads, weather exposure, etc. Story height walls will sustain axial loads of about 50% of the strength of the unit or from 350 to 500 pounds per square inch on the gross section. The allowable working stress in such walls ranges from 70 to 85 pounds per square inch on the gross section, depending upon the strength of mortar. The resulting safety factory is 4-1/2 or greater.

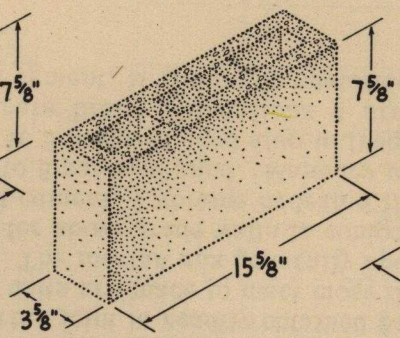
The weight of the units depends upon their size and type of aggregate -- typical 8"x8" x16" units weigh about 42 pounds if made of sand and gravel aggregate and 30 pounds if made with a lightweight aggregate.



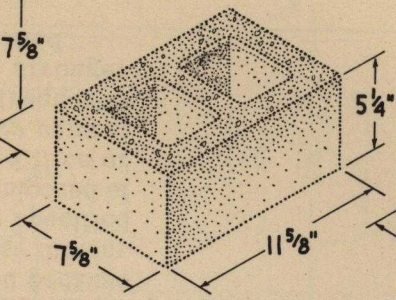
THREE CORE UNIT
ALSO HALF UNIT



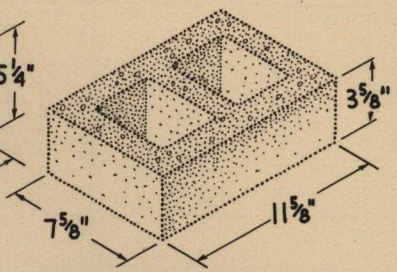
TWO CORE UNIT



PARTITION UNIT
WIDTH MAY VARY

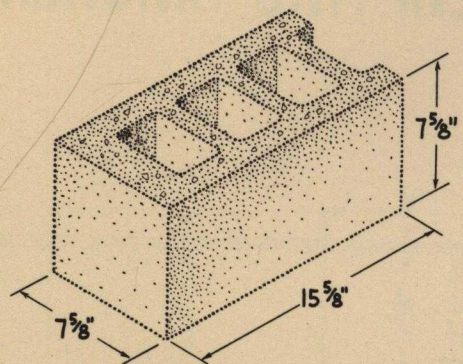


TWO CORE UNIT
ALSO HALF UNIT

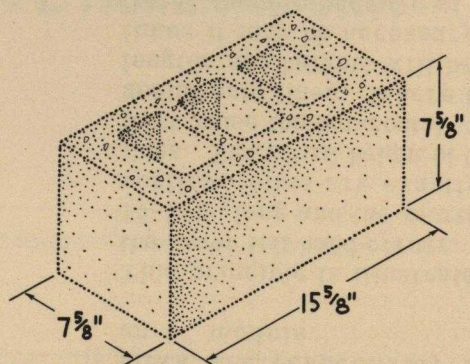


TWO CORE UNIT
ALSO HALF UNIT
HEIGHT MAY VARY

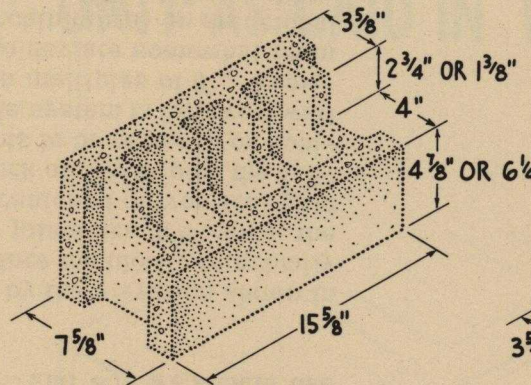
CONCRETE MASONRY WALL UNITS



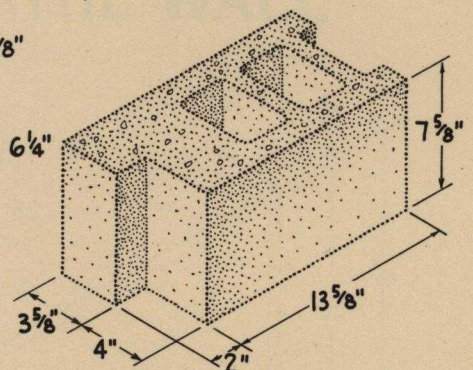
CORNER UNIT
ALSO HALF UNITS



PIER OR DOUBLE CORNER UNIT



HEADER UNIT



JAMB UNIT
WOOD OR STEEL WINDOW
ALSO HALF UNIT

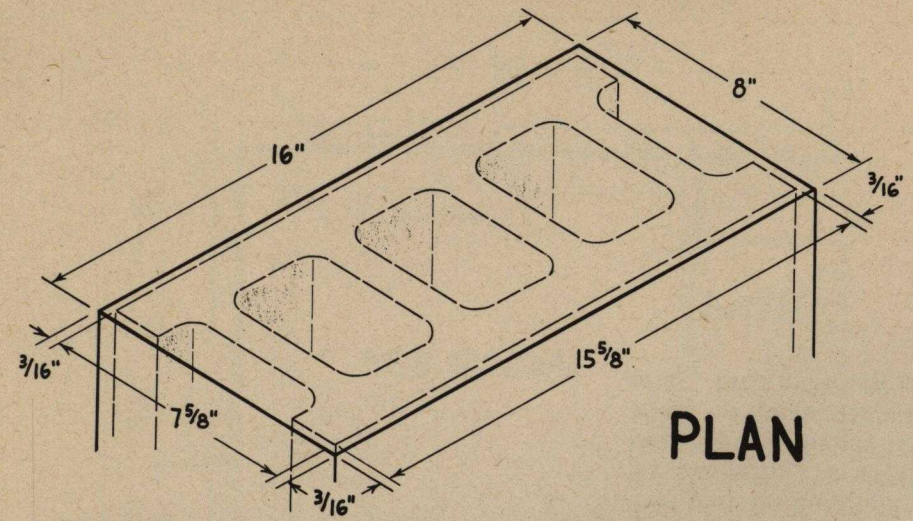
STANDARD SPECIALS CONCRETE MASONRY WALL UNITS

3"-4"-6"-8"-10"-12" NOMINAL WIDTHS

In applying modular coordination in laying out concrete masonry walls, it is necessary first to adopt a module or grid system which is compatible with the standard block sizes. Secondly, the block must be fitted to this grid system so that special lengths or sizes are avoided. Since the nominal length and height of standard block are respectively 16" and 8", we should use an 8" module.

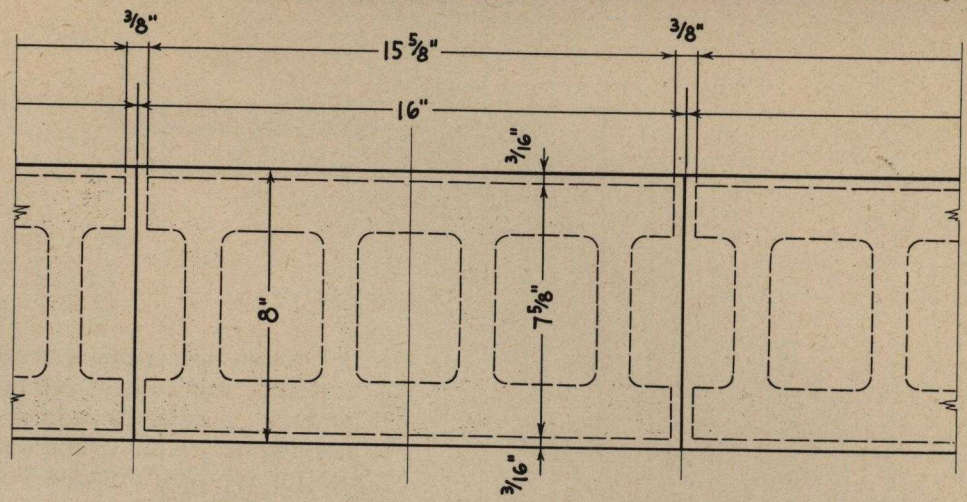
This principle is illustrated by the elevation shown in the lower left hand corner. Since the block are actually 15-5/8" long and the mortar joints are 3/8" wide, the vertical joints are exactly centered on vertical grid lines. The actual height of block of 7-5/8" plus the 3/8" joint cause the horizontal joints to be centered on horizontal grid lines. Where this system is followed, wall lengths and heights will be in multiples of 8". Sometimes it may be necessary to deviate somewhat from the 8" module because of architectural or structural considerations. In these cases, a 4" module should be applied to the affected portion of the masonry.

The other figures graphically illustrate the 3 dimensional relationship of the actual size modular unit with respect to nominal size and the grid lines. The standard 3/8" mortar joint is readily obtained because concrete masonry units are made to meet close dimensional tolerances. The mortar mix generally specified and recommended for above grade walls is composed of 1 volume portland cement, 1 volume hydrated lime or lime putty, and 5 to 6 parts of sand. Masonry cement mixed with 2-1/2 to 3 parts of sand also is frequently used. For concrete block foundations a stronger mortar, richer in cement, is generally specified.

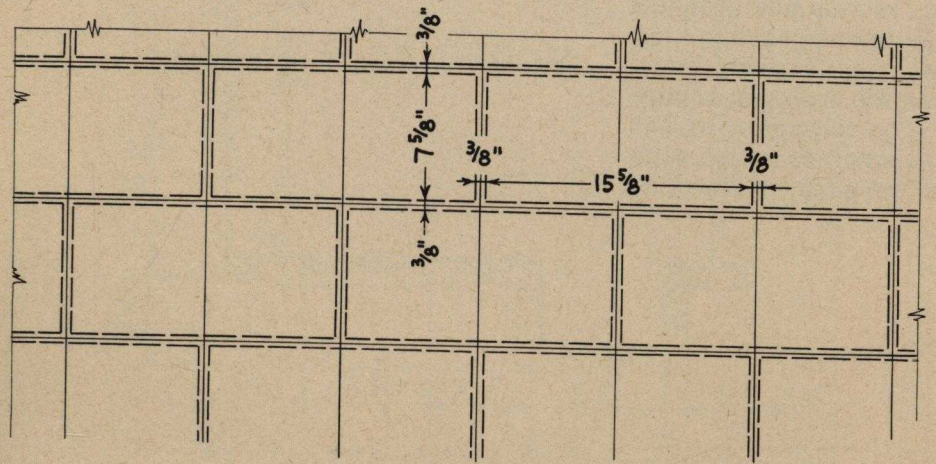


PLAN

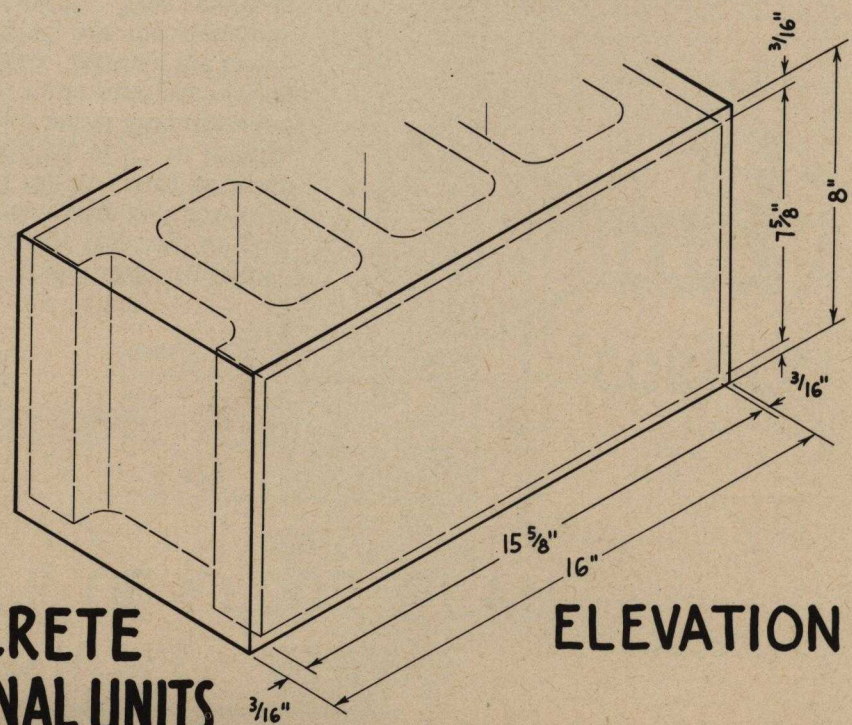
ACTUAL SIZE MODULAR CONCRETE MASONRY UNIT INSIDE NOMINAL UNIT



NOMINAL UNIT AND ACTUAL SIZE UNIT AS LAID IN THE WALL



ACTUAL SIZE MODULAR CONCRETE MASONRY UNITS INSIDE NOMINAL UNITS

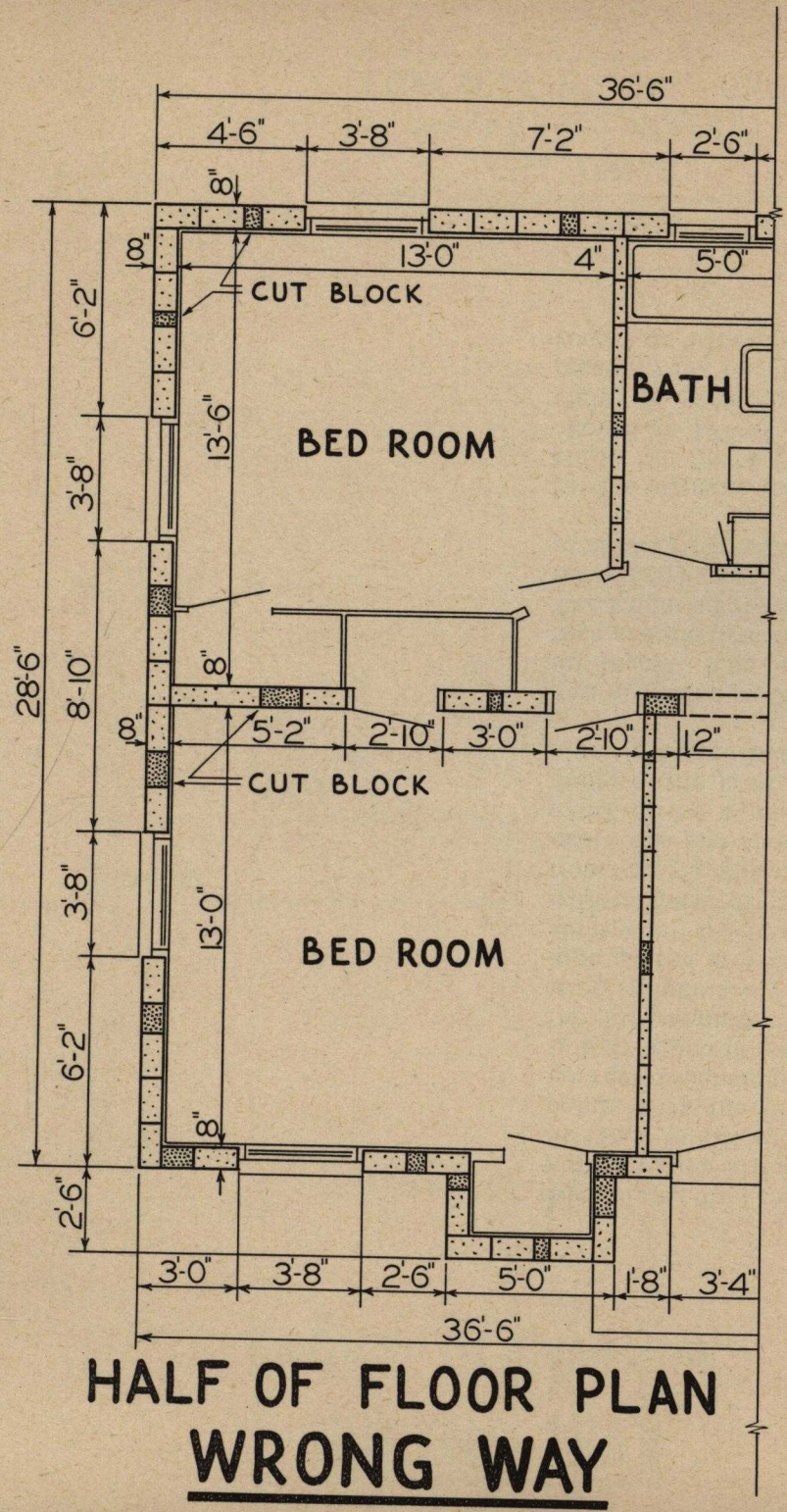


ELEVATION

In making a modular layout the first step is to determine the overall outside dimensions so that wall lengths are in multiples of 8". The next step is to locate window and door openings so that the masonry between these openings will be in multiples of 8" in length. This is possible with proper selection of modular size windows and doors. On the left hand side the wrong way of making a layout is illustrated. Neither the overall length of 36'6", the width of 28'6", nor the distances between openings are multiples of 8". The result is that a large number of fractional lengths would be required, which are indicated by the dark shaded units in the wall section. It would be expensive to cut these block on the job and the resulting appearance of the masonry would not be as pleasing as where the standard full and half-length units are used.

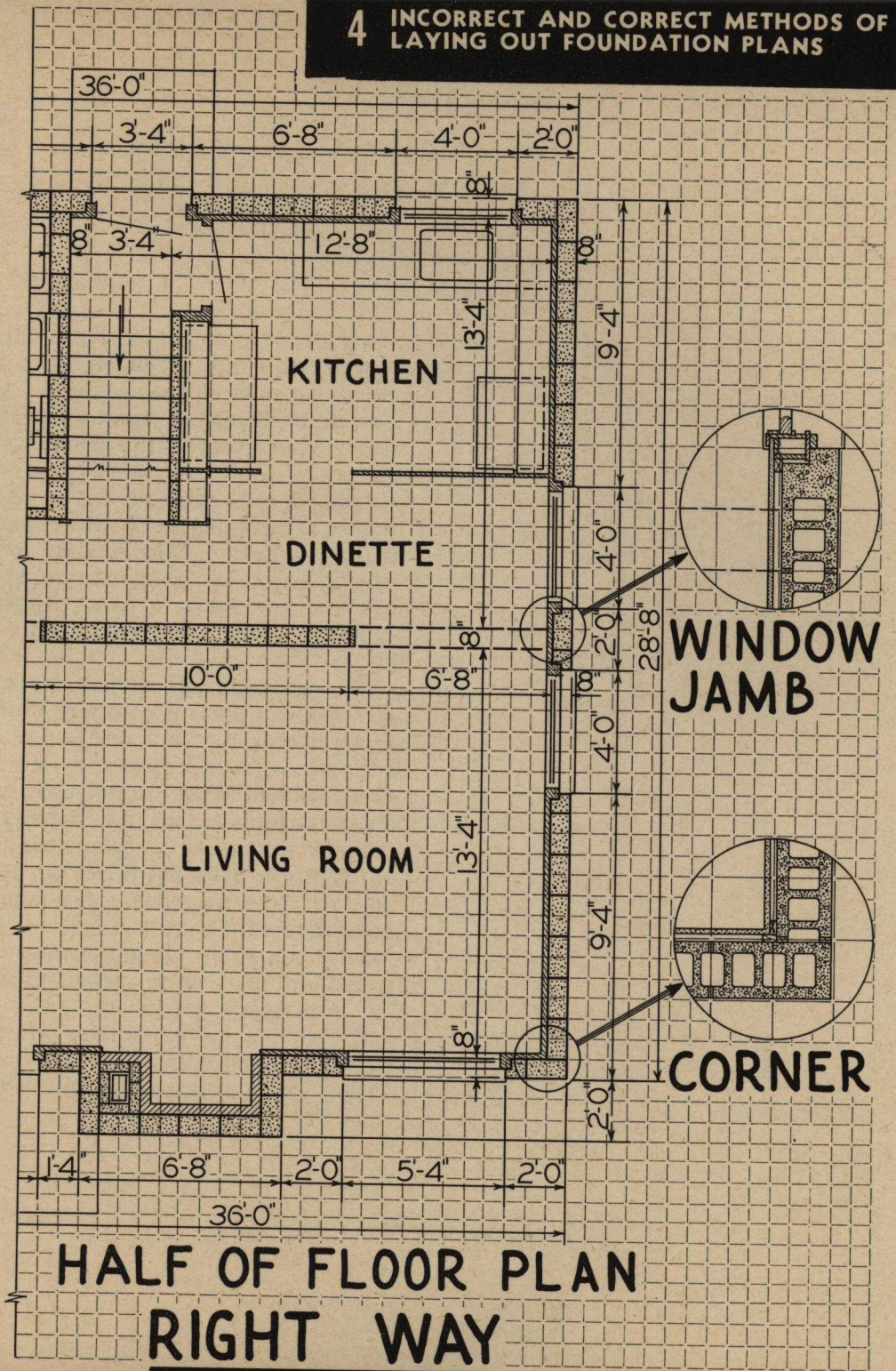
The plan on the right shows a correct modular layout. By changing the width of the house only 2 inches and the length 6 inches, and by proper spacing of modular width openings, all horizontal dimensions are multiples of 8", thus avoiding need for any odd length units.

4 INCORRECT AND CORRECT METHODS OF LAYING OUT FOUNDATION PLANS



HALF OF FLOOR PLAN

WRONG WAY



HALF OF FLOOR PLAN

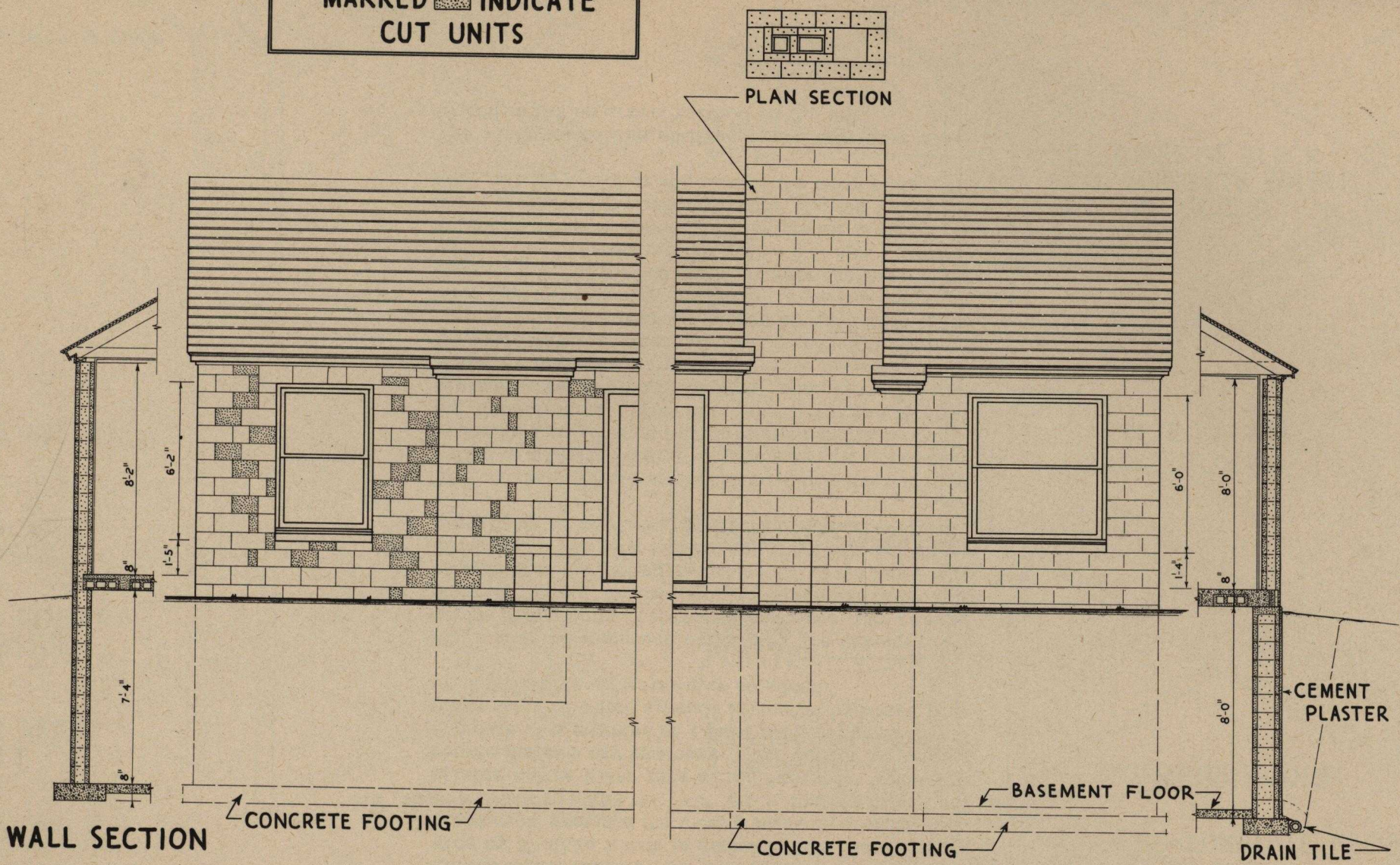
RIGHT WAY

In applying dimensional coordination it is necessary to not only give attention to wall heights but also to the distance to sill and lintel levels and other controlling points. On the left hand side which illustrates incorrect dimensioning, the height of the first story wall is 8' 2" which is not a multiple of 8". In order to meet the non-modular dimension, a 4-inch high course is used immediately above the foundation wall and a 6" high course is used at the top of the wall. Neither the window sill height nor the height of the window conform with modular dimensioning, with the result that fractional height units are required below the precast concrete sill and under the ends of the lintel. Also, the width of the window is not modular -- consequently some of the jamb units are of odd lengths. The odd size units are indicated by dark shading.

The elevation on the right side shows a correct modular layout. The foundation wall is exactly 12 courses high and the first story wall is exactly 13 courses high. The height and width of the window are modular so that the window head coincides with the regular horizontal joint and jamb units are of standard full or half lengths.

In this example the basement walls extend about 7 feet below the finish grade and their thickness therefore should be 10" or 12" as shown in the section on the right. Most building codes permit 8" thick hollow unit masonry for foundation walls if they do not extend beyond 4 or 5 feet below grade.

CONCRETE MASONRY UNITS MARKED ▨ INDICATE CUT UNITS



FRONT ELEVATION
WRONG WAY

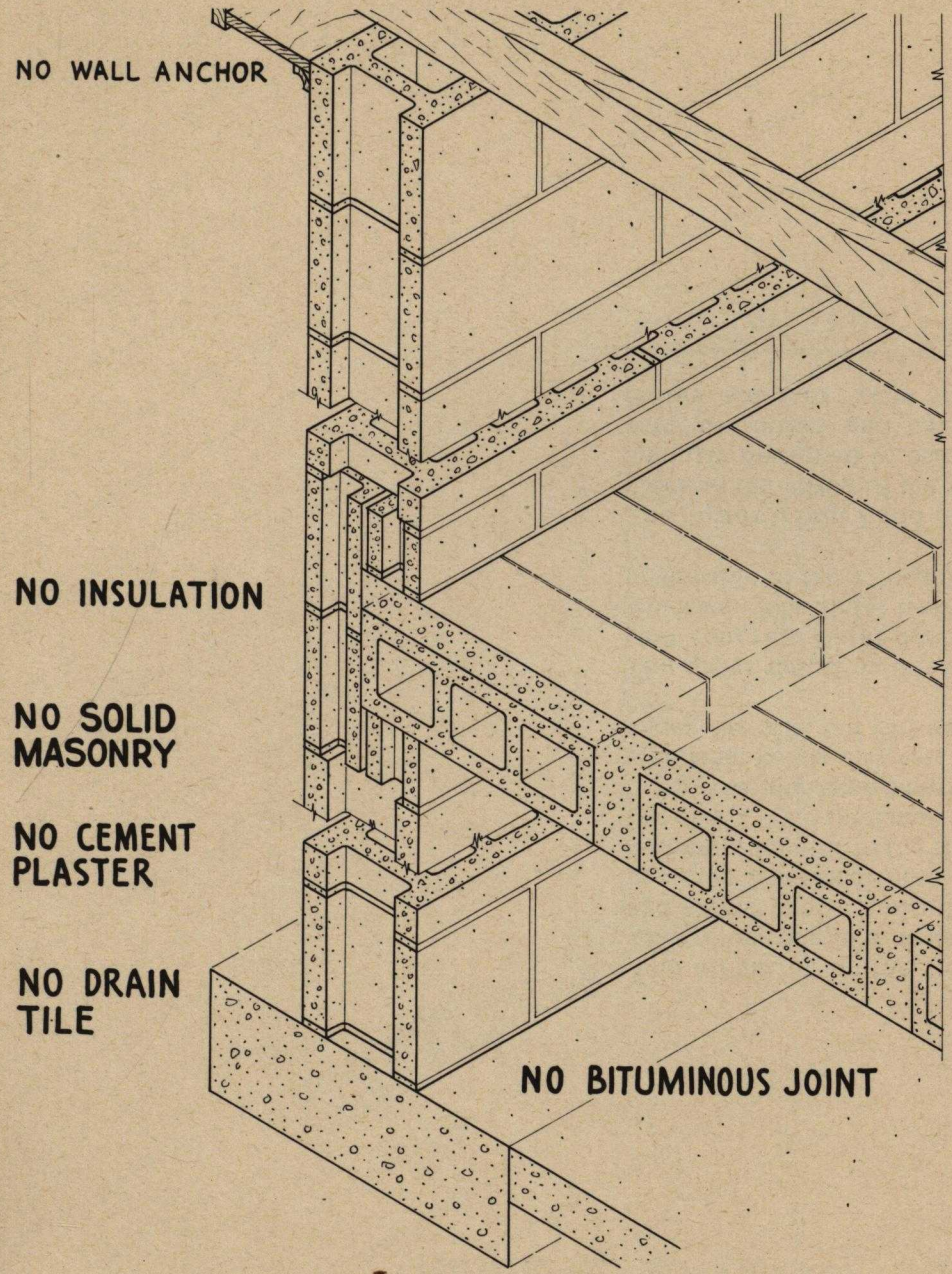
FRONT ELEVATION
RIGHT WAY

The right hand drawing shows the principal wall details properly constructed. The concrete footing is 16" wide by 8" deep which is adequate for 1 and 2 story residences, provided the footing bears on average soil. The drain tile and the 1/2" thick coating of cement plaster on the outer face of the basement walls will help to insure a dry basement. Such plaster or parging consists of a mixture of 1 part portland cement to 3 parts sand, to which a small amount of hydrated lime or plasticizing material may be added.

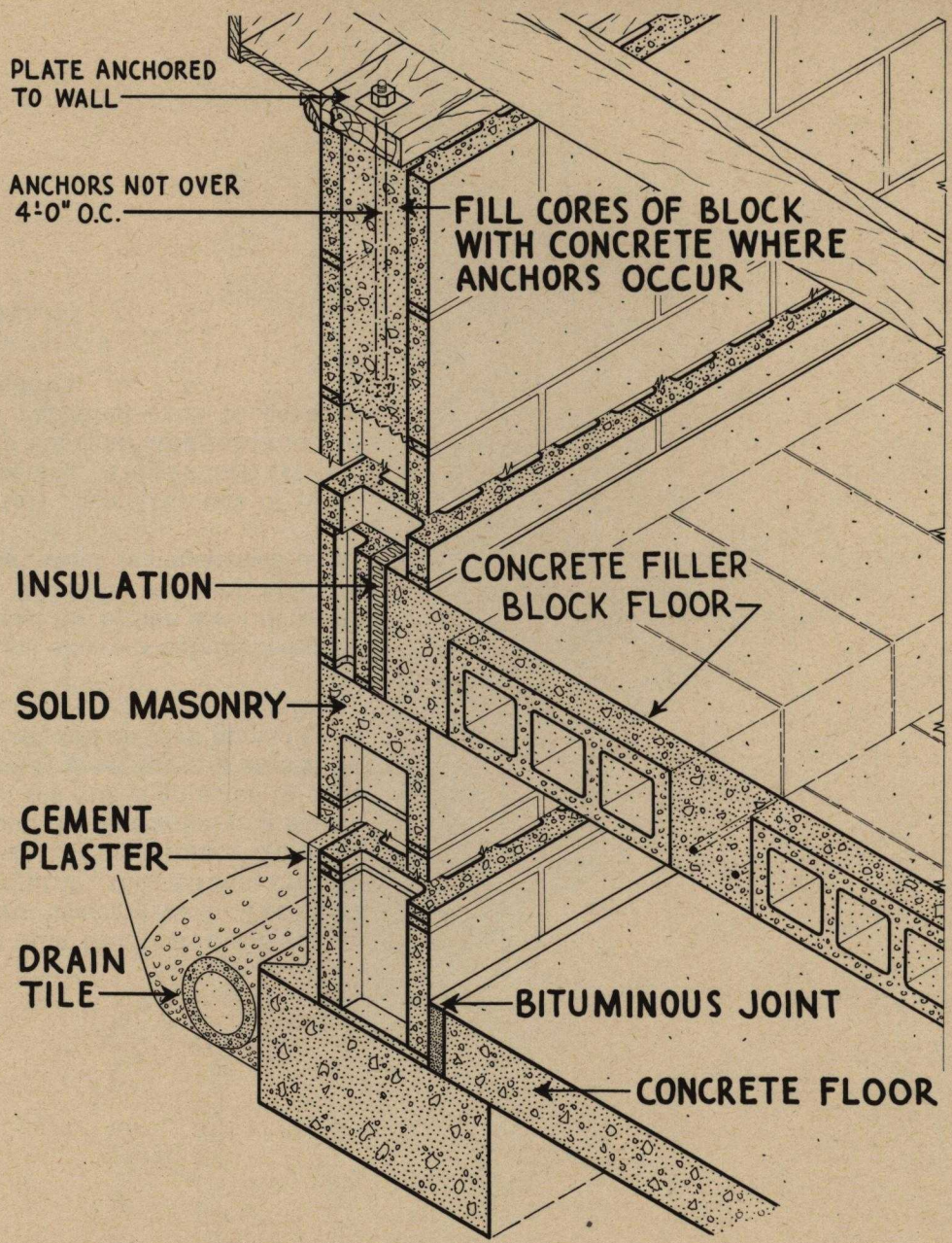
When unusual moisture conditions are encountered, apply bituminous waterproofing over the cement plaster. The 4" thick concrete basement floor slab extends over the footing to within 1/2" of the inner face of the wall. The joint can then be filled with hot tar or asphalt, as an additional precaution against seepage.

The concrete joist-concrete filler block floor is supported on a bearing course of solid masonry as required by the Federal Housing Administration and many building departments. The concrete floor has a solid perimeter beam so that vertical loads from the wall above are adequately transmitted to the foundation wall. To guard against excessive heat loss a strip of preformed insulating board is placed between edge of the floor slab and masonry. At the top of the exterior wall, there is a 2" thick wood plate securely anchored to the masonry by bolts spaced not over 4 feet apart and imbedded in grout or concrete filled into the cores of the block in which the anchors occur. Ceiling joists and roof rafters are then attached to the wood plate.

The essential details outlined above have been overlooked in the incorrect method on the left.



WALL DETAILS
WRONG WAY

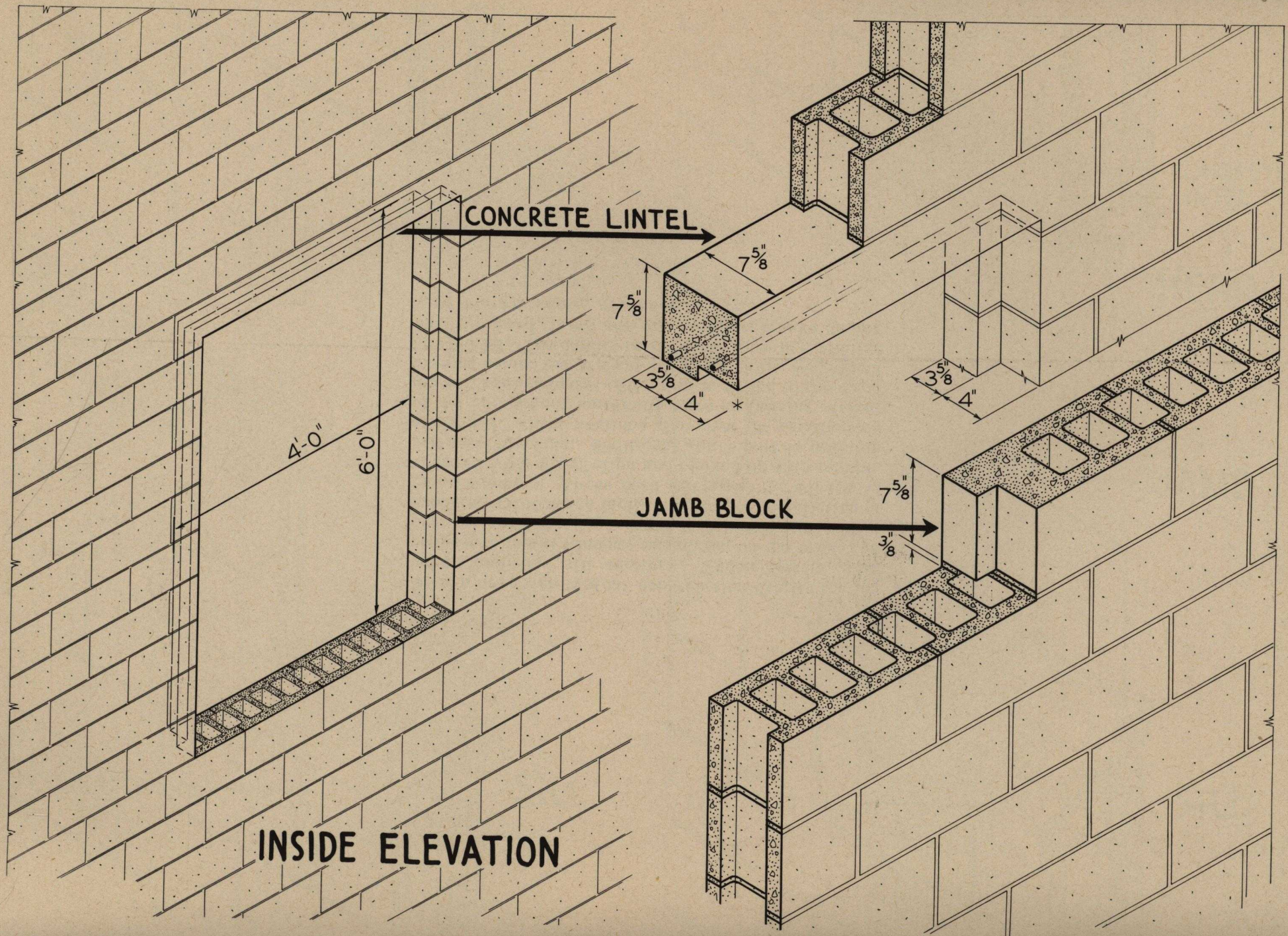


WALL DETAILS
RIGHT WAY

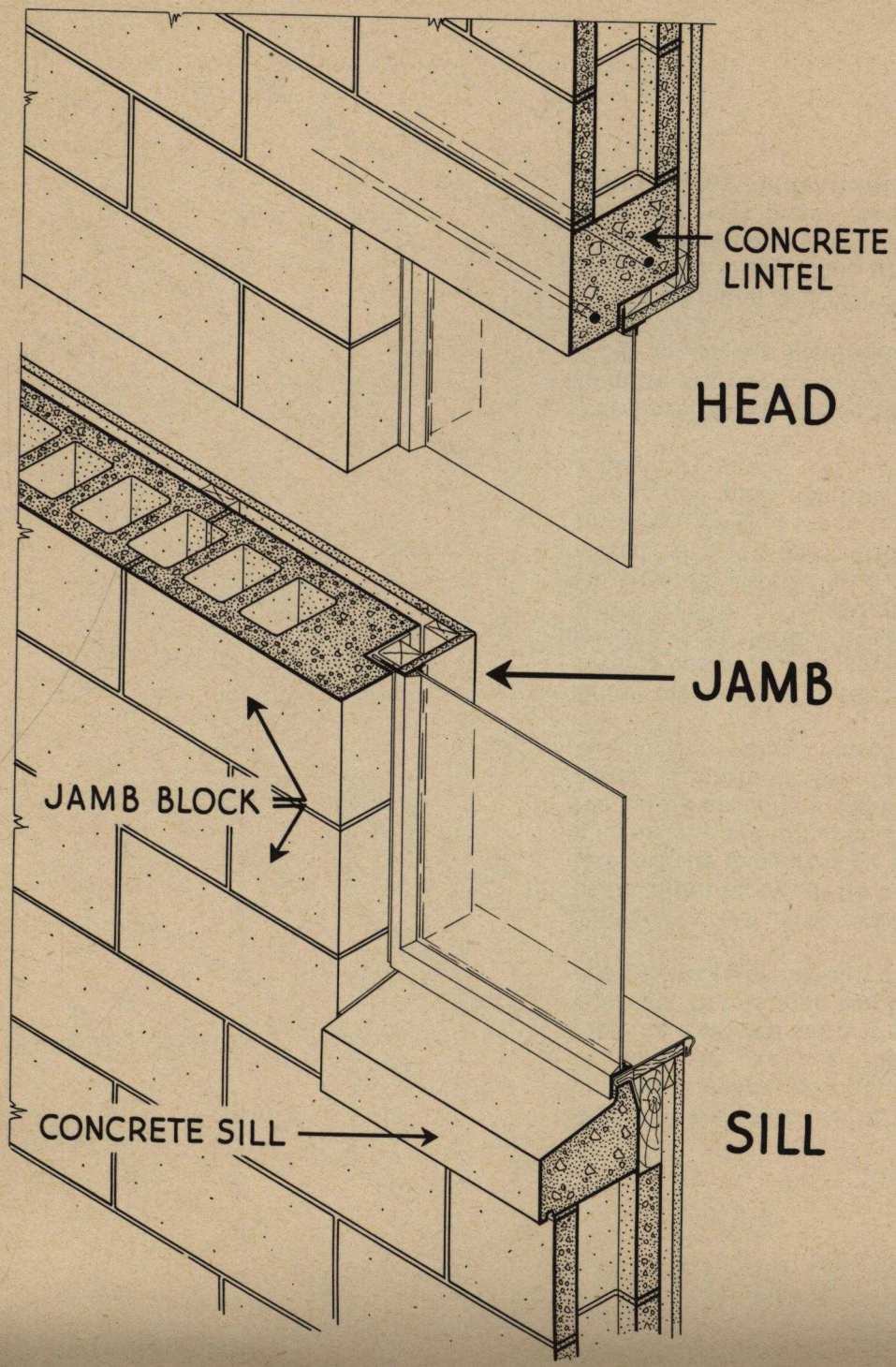
The elevation on the left side illustrates a modular window opening in a concrete masonry wall. The width and height are in multiples of 8", thus eliminating the need for fractional size units. The distance from the bottom of the sill to the top of the foundation is a multiple of 8". The thickness of the sill is adjusted to conform with the sash height. If necessary, a course of fractional height concrete units can be used immediately under the sill, but this should be avoided if possible.

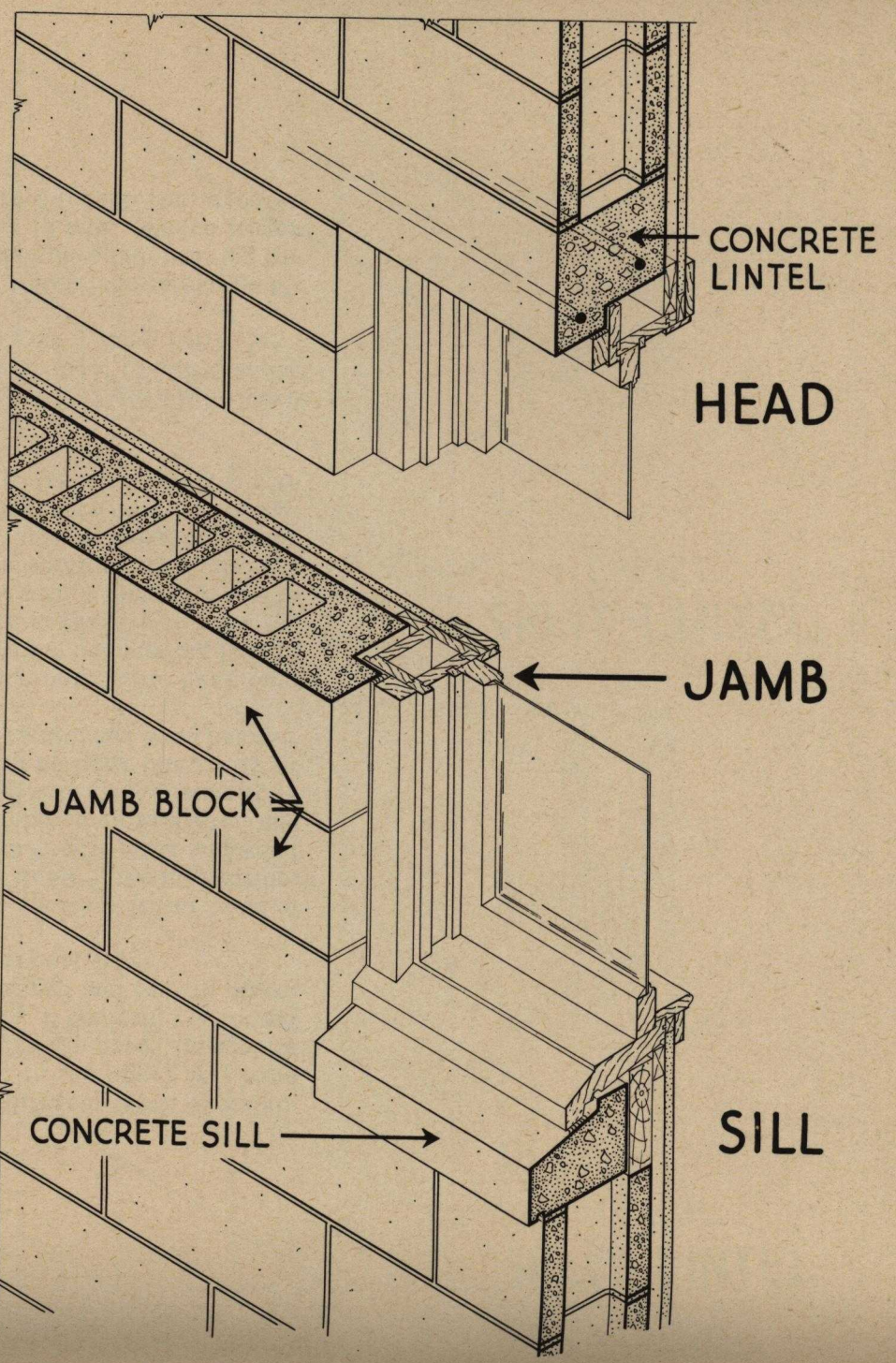
The upper detail on the right shows a reinforced precast concrete lintel designed for either steel or wood windows. The lintel bears 8" on the masonry which is preferable to the 4" bearing, which is sometimes used.

The lower right hand detail shows the use of jamb block at the edges of the opening. These block are especially designed to carry concentrated loads at the ends of lintels and have rabbeted ends to receive either steel or wood windows.


CONCRETE LINTEL
7 5/8"
7 5/8"
3 5/8"
4"
*
3 5/8"
4"
4'-0"
6'-0"
JAMB BLOCK
7 5/8"
3/8"
INSIDE ELEVATION

Shown here are typical construction details for the head, jamb and sill sections. These details, with respect to metal windows are shown on the left. The precast reinforced concrete lintel is made with a rabbeted soffit which facilitates proper installation of metal windows. At the head and jambs the window is secured with metal clips and backed up with mortar and wood blocking. Additional attachment is possible at the sill. These sections also show the relationship of the component materials such as furring strips, plaster and masonry. Attention is called to the wood backing behind the precast sill to which the wood stool is secured. The details on the right show in a similar wall the head, jamb and sill sections where double hung wood windows are used.


CONCRETE LINTEL
HEAD
JAMB
JAMB BLOCK
CONCRETE SILL
SILL


CONCRETE LINTEL
HEAD
JAMB
JAMB BLOCK
CONCRETE SILL
SILL

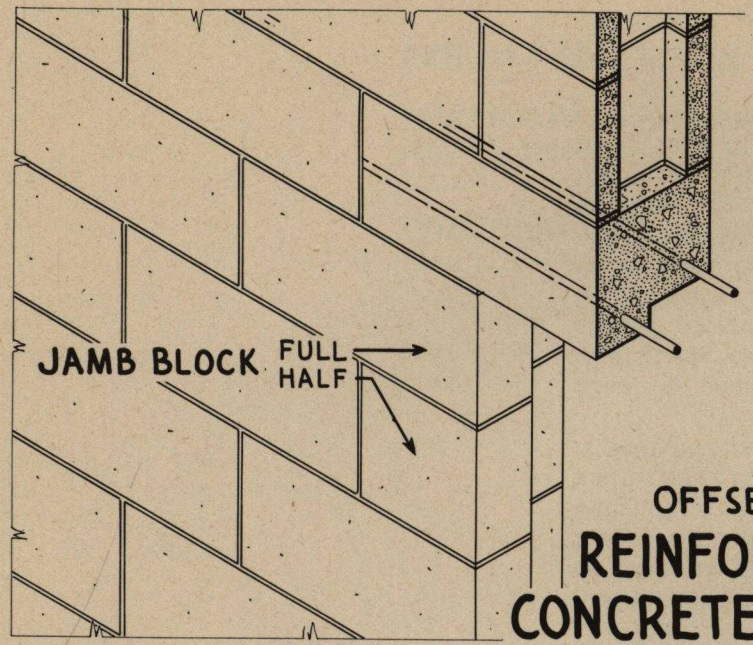
Shown above are some of the different types of lintels used with concrete masonry. In the upper left hand drawing the precast reinforced concrete lintel with offset or rabbeted soffit is shown. If desired, reinforced concrete lintels also can be formed and cast in place. Most contractors prefer the precast type.

The lower left hand drawing shows a lintel built of beam lintel block. With beam lintel block in position, temporarily supported by a 2"x8" soffit plank and wood shores, the reinforcement is placed as indicated and the hollow space is solidly filled with good quality concrete. Lintels of this type can be built integrally in conjunction with a continuous reinforced bond beam.

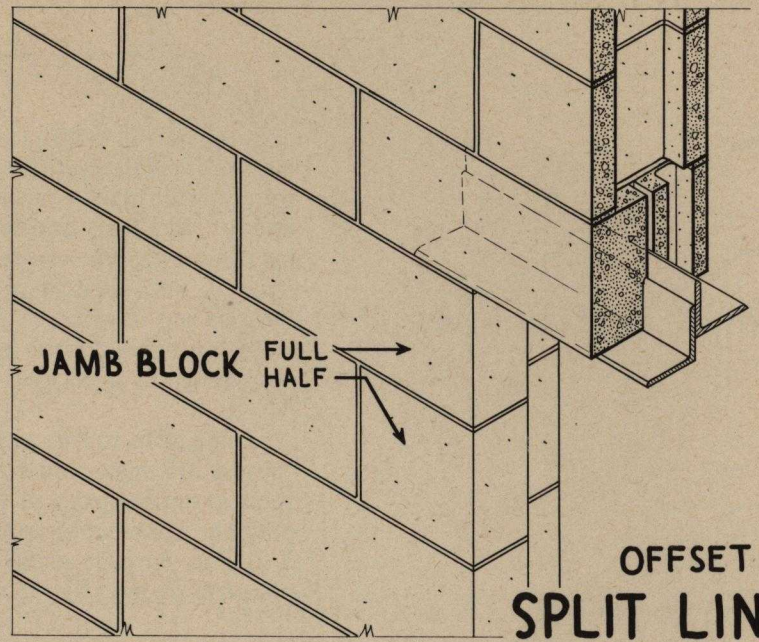
In the offset split lintel the masonry units bear on a leveled bed of mortar spread on the outstanding legs of welded steel angles. It may be necessary to cope the inner face of the outside units with a masonry saw to fit over the vertical leg of the outside angle. An alternative is to use solid or hollow units of lesser thickness so that there is a clearance without coping. The inside units must be cut to fractional height with a masonry saw.

The lintel detail shown in the lower right hand figure is quite similar to one just described, except that the steel angles are positioned to give a flush soffit.

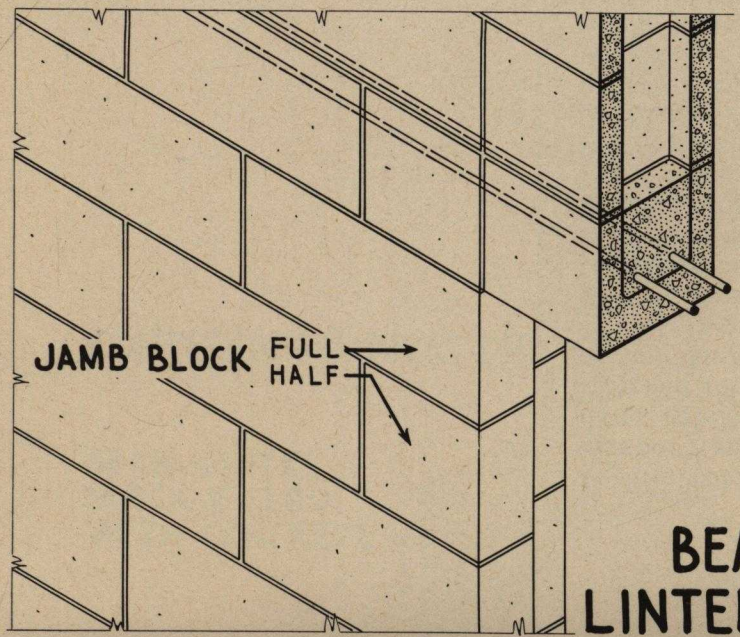
It will be noted that all of the lintels shown extend 8" beyond the jamb. This provides adequate bearing for most lintels up to spans of 8 or 10 feet. Where longer spans or very heavy loads are encountered, greater bearing may be desirable.



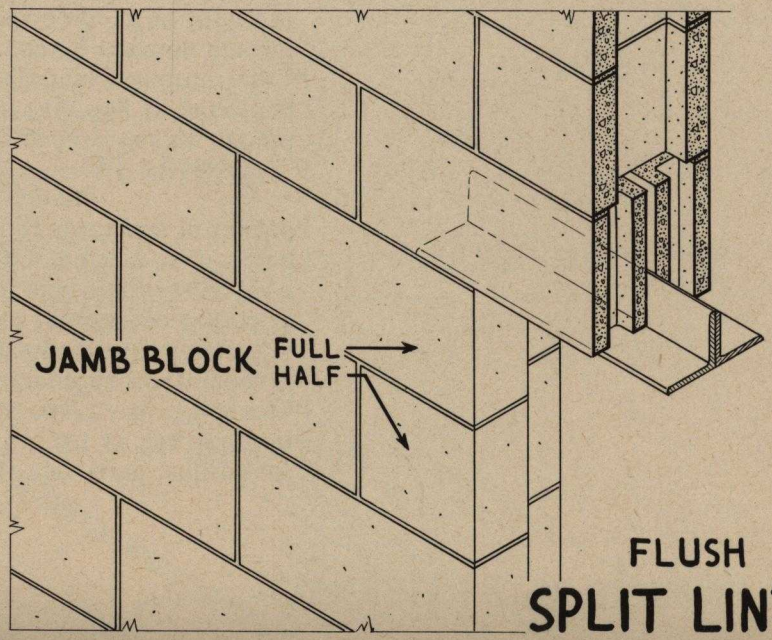
OFFSET
REINFORCED CONCRETE LINTEL



OFFSET
SPLIT LINTEL



BEAM LINTEL BLOCK



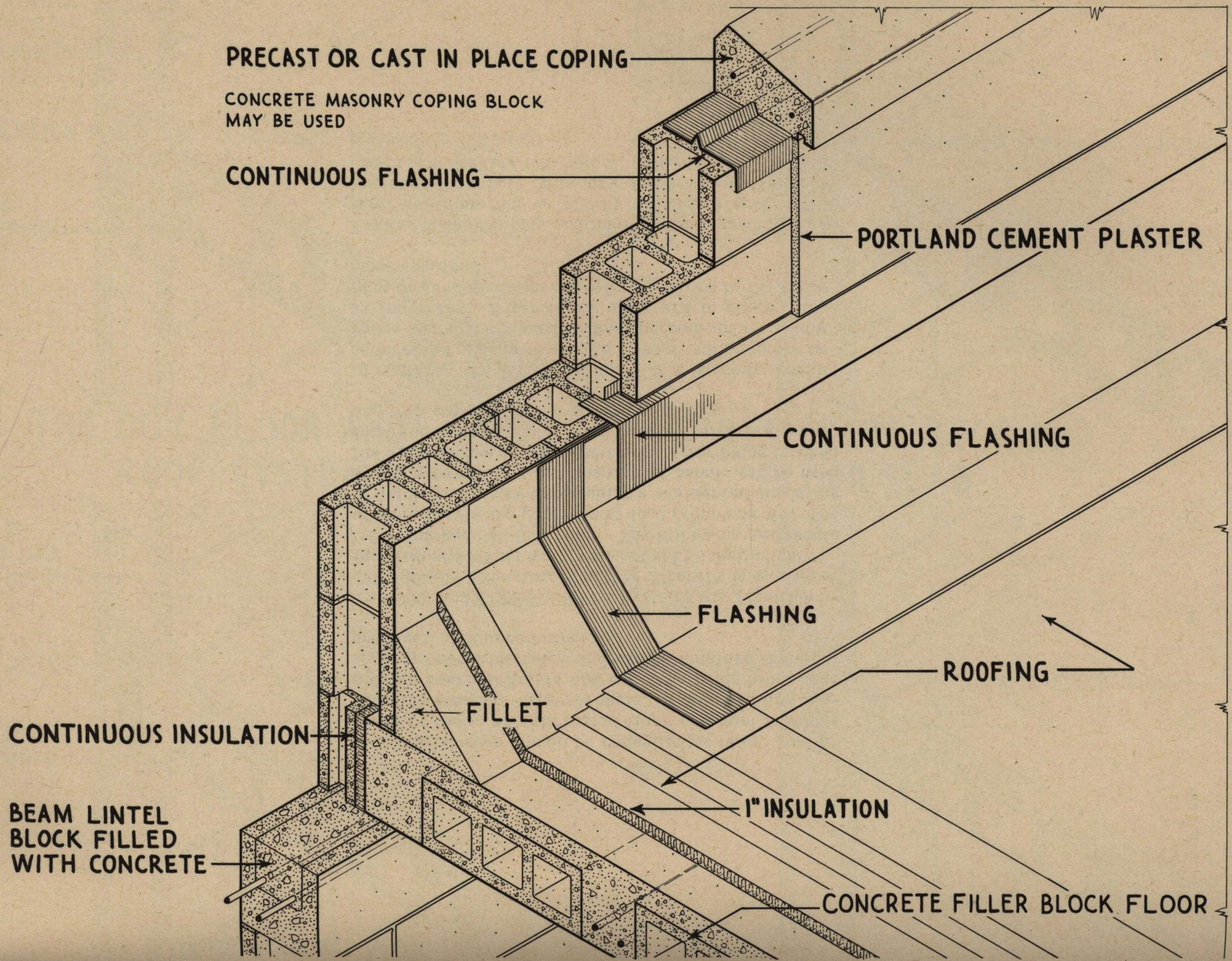
FLUSH
SPLIT LINTEL

In this roof and parapet detail the first course of masonry under the roof slab is built of beam lintel block reinforced and filled with concrete. Such reinforced concrete bond beams extending continuously around the structure greatly strengthen the masonry. The strip of waterproofed rigid insulation board is placed between the edge of the roof slab and the masonry to reduce heat loss. This parapet wall, which here is shown 5 block courses high, is 8" thick and is topped with a precast or cast in place coping.

Where possible, coping block of standard design should be utilized. Continuous through flashing is provided under the coping so as to guard against possible leakage into the parapet, should the coping develop cracks or the joints between the units open up. The joints of precast coping units should be calked with elastic calking compound.

The concrete joist-concrete filler block roof is covered on top with 1" insulation and built up roofing of 3 to 5 layers of roofing felt with each layer thoroughly mopped with hot tar or asphalt. The fillet at the junction of roof and parapet is built of stiff consistency concrete which, if desired, may be made with lightweight aggregate.

Flashing consisting of multiple layers of roofing felt, alternating with hot tar or asphalt extend from the continuous counterflashing downward to overlap the roofing 8" or more. The continuous counterflashing of noncorrodable metal is imbedded in the mortar joint as shown and turned down to overlap the flashing. As an additional precaution against moisture infiltration into the parapet, portland cement plaster is applied to the inner face of the parapet in the region above the top of the flashing.

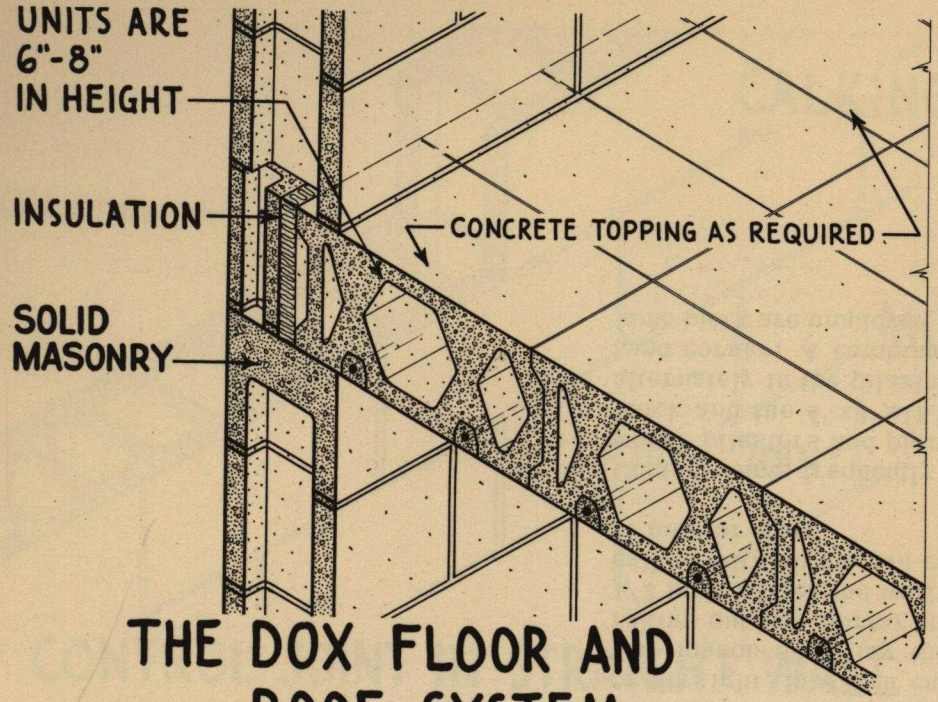

PRECAST OR CAST IN PLACE COPING
CONCRETE MASONRY COPING BLOCK MAY BE USED
CONTINUOUS FLASHING
PORTLAND CEMENT PLASTER
CONTINUOUS FLASHING
FLASHING
ROOFING
FILLET
CONTINUOUS INSULATION
1" INSULATION
BEAM LINTEL BLOCK FILLED WITH CONCRETE
CONCRETE FILLER BLOCK FLOOR

Local producers should be consulted as to the availability of these prefabricated floor and roof systems utilizing concrete masonry units. A fifth system, employing concrete joists and concrete filler block, has already been illustrated and can be obtained from any producer of concrete masonry.

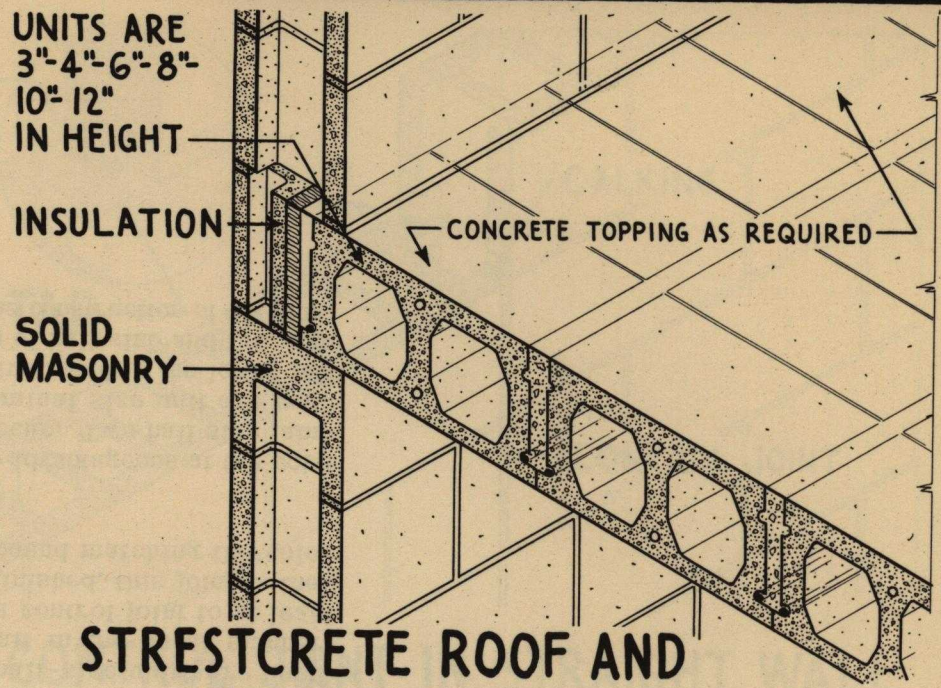
The DOX and STRESTCRETE Systems are plant fabricated panels consisting of hollow concrete units aligned in a row and structurally connected by longitudinal reinforcing bars as indicated. The thickness and length of these panels are governed by load requirements. The 6" thick panels are applicable to residential loads for spans up to about 18 feet and thicker panels can be used for longer spans and heavier loads. After being trucked from the factory and erected with a mobile crane they are then covered with a concrete topping.

In contrast, the JOISTILE and F & A Systems consist of inverted precast concrete T-sections or joists between which are placed hollow concrete masonry units as indicated. After these units are in place a topping of good quality concrete is poured to the thickness required.

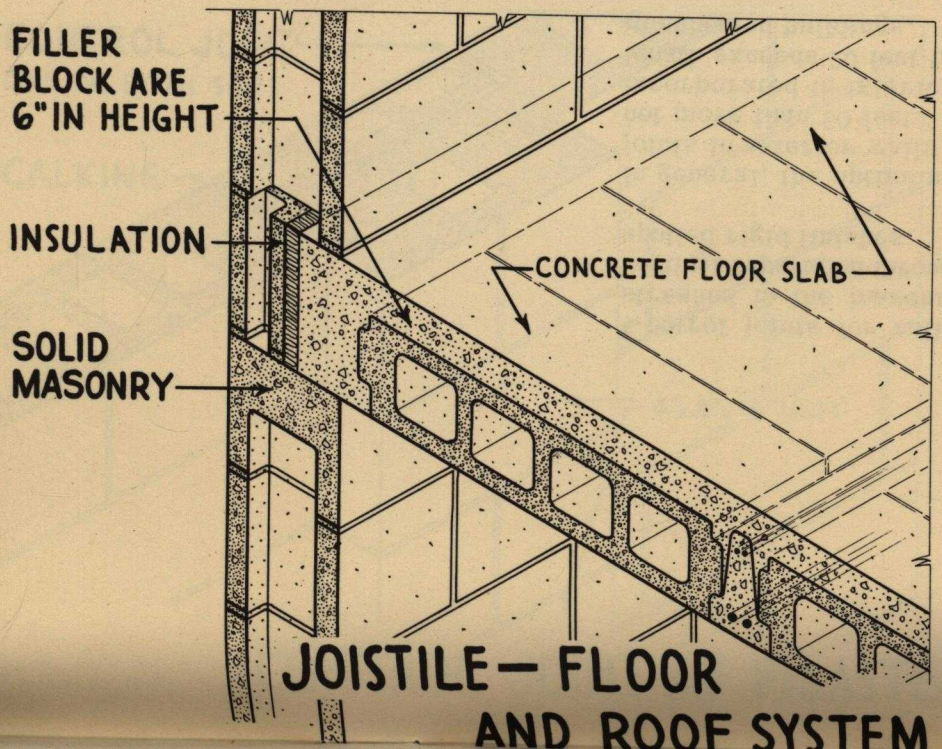
Further technical data and information regarding these floor systems may be had by writing directly to the National Concrete Masonry Association, 38 South Dearborn Street, Chicago 3, Illinois.



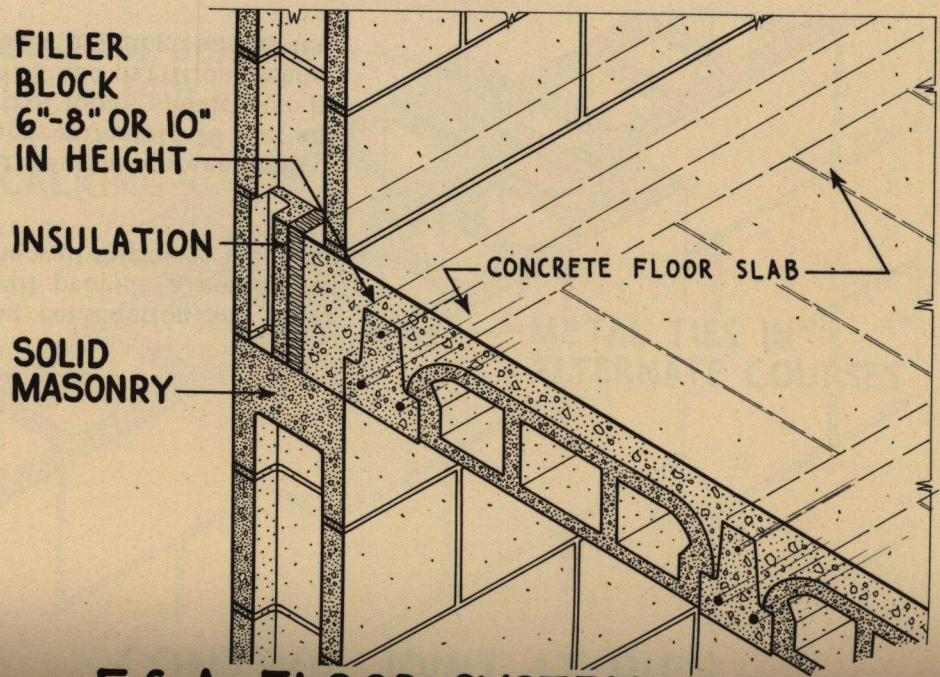
THE DOX FLOOR AND ROOF SYSTEM



STRESTCRETE ROOF AND FLOOR SLAB



JOISTILE— FLOOR AND ROOF SYSTEM



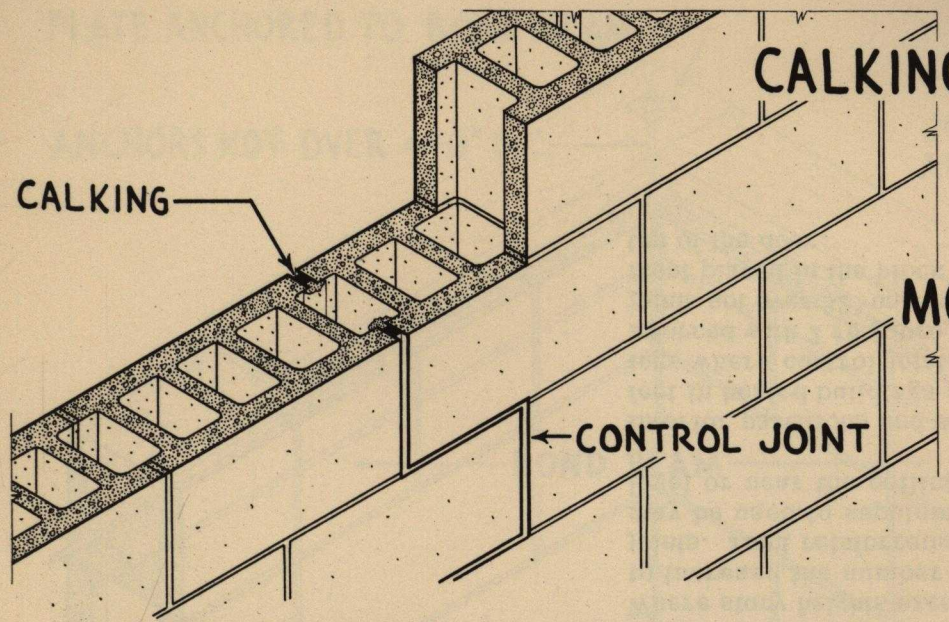
F & A FLOOR SYSTEM

Control joints for relieving contraction and other stresses in the masonry will provide a continuous vertical separation through the wall thickness including applied rigid finishes.

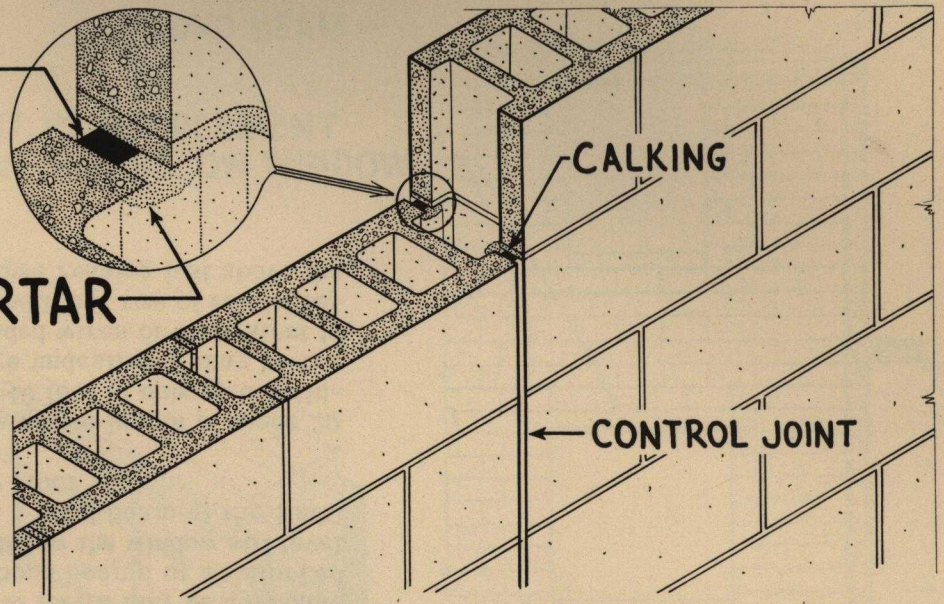
In general, the optimum wall length between control joints in exterior walls is approximately 20 feet and not more than 50 feet. Control joints should also be incorporated in interior walls and partitions whose length exceeds 20 feet in heated buildings and 40 feet in unheated buildings.

Control joints in straight walls are either staggered or straight, in which case half-size units are used. The mason shall lay the wall in the usual manner, raking out the mortar in the control joint to at least 1/2 inch. After the wall is finished, this joint is then calked with an elastic compound matching the color of mortar used.

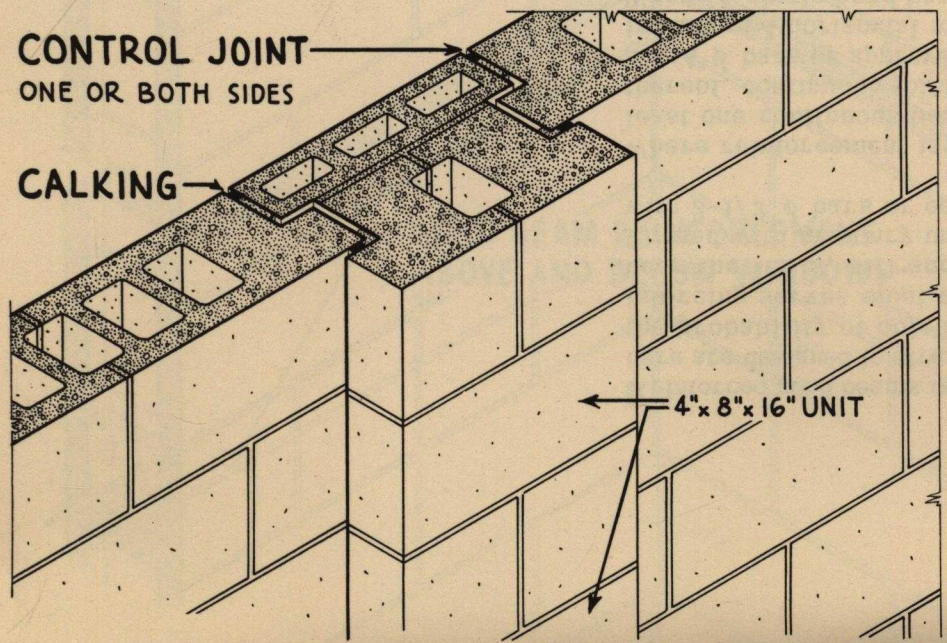
Control joints frequently are advantageous at the point where pilasters and piers occur. Two half size jamb block and the 4"x8"x16" nominal size unit are used alternately in the pilaster illustrated in the lower left hand corner. A combination of half size and full size jamb block are employed in the construction of the pier.



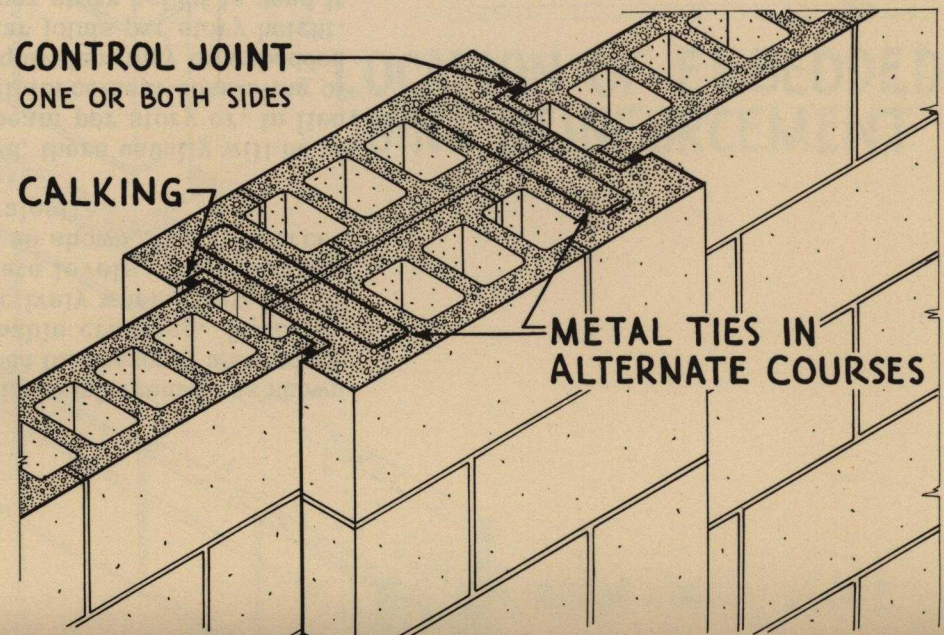
CONTROL JOINT IN STRAIGHT WALL



CONTROL JOINT IN STRAIGHT WALL



CONTROL JOINT AT PILASTER



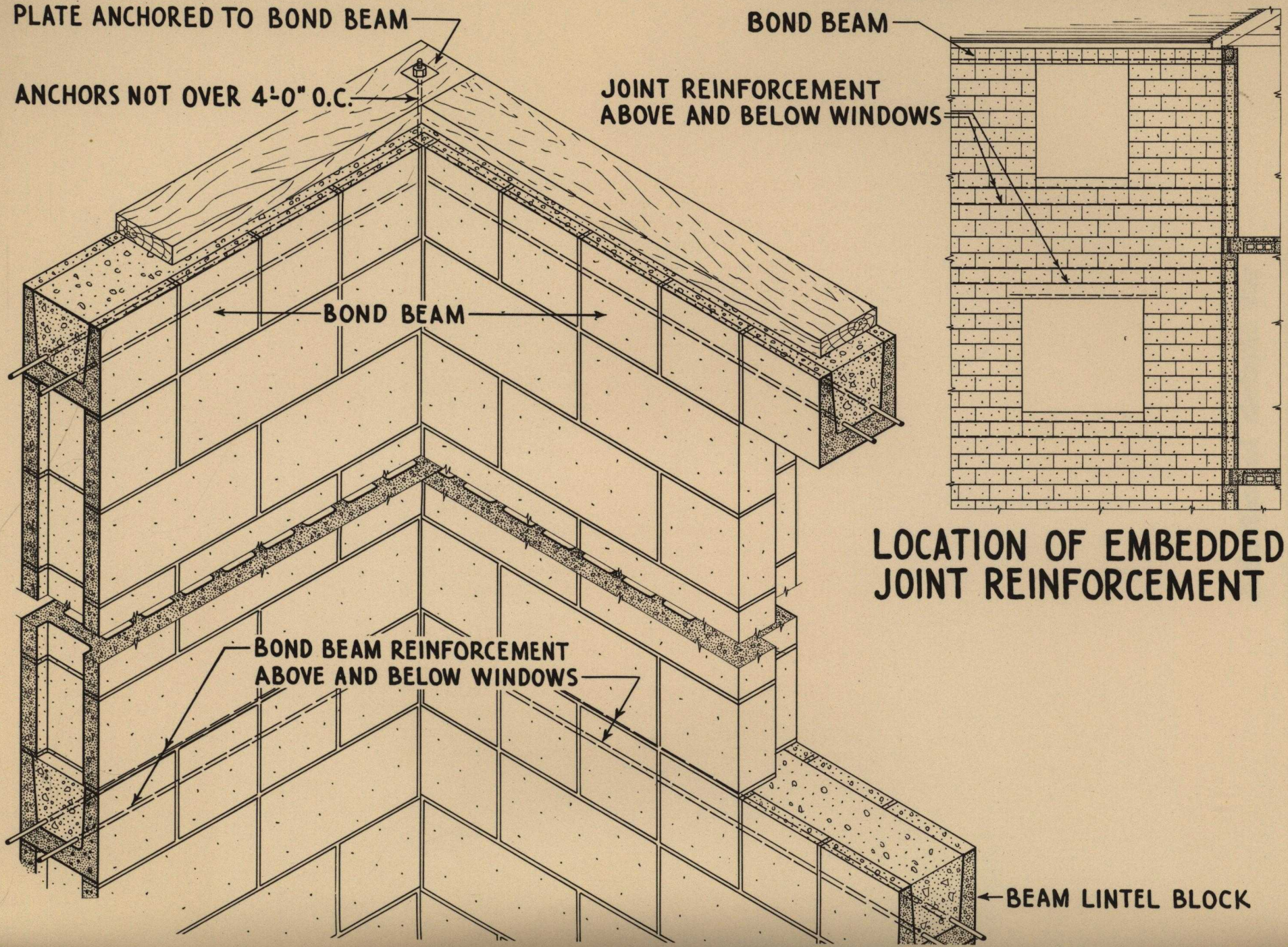
CONTROL JOINT AT PIER

Reinforced bond beams or joint reinforcement as shown here are designed to strengthen the masonry and reduce the probability of objectionable cracking. Such reinforcing serves most effectively when located at or near the lintel, sill and plate levels. Bond beams, formed with masonry units as shown, are reinforced with 2-1/2" ø bars or equivalent.

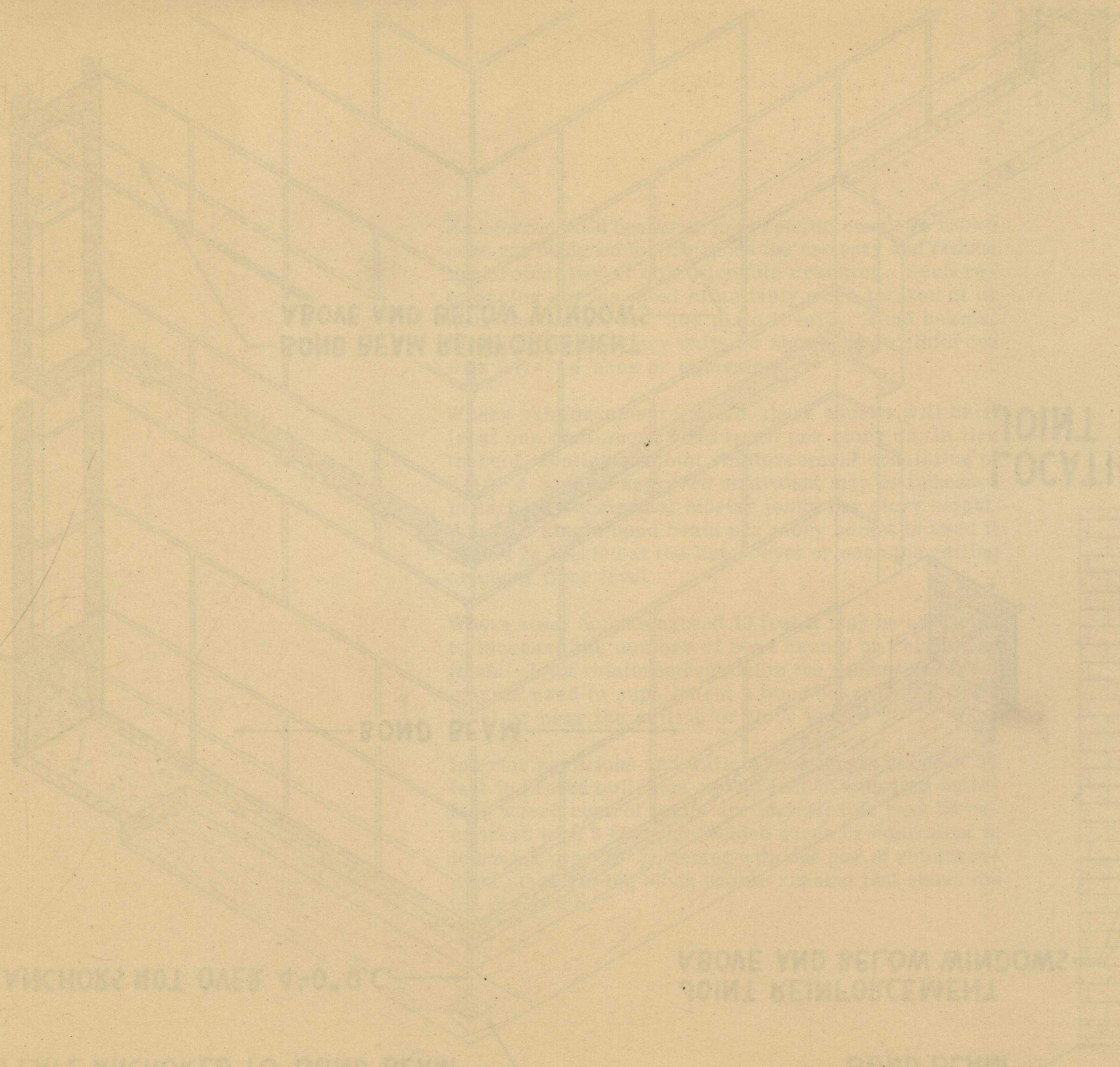
Where reinforcement is used, there usually will be at least one continuous bond beam per story or, in lieu thereof, continuous joint reinforcement consisting of 2-1/4" ø bars or approved equivalent may be imbedded in each of 4 horizontal mortar joints per story height. Where a single bond beam per story height is used it should be located at the lintel level or near the ceiling or upper floor level.

Where story heights exceed 10 feet it may be advisable to increase the number of bond beams or reinforced joints. Joint reinforcement below the window sill level may be used to supplement a bond beam at the lintel level or near the ceiling or floor level.

Interior partitions and walls whose length exceeds 20 feet in heated buildings and 40 feet in unheated buildings where control joints are undesirable may be reinforced with 2 #6 gauge welded wires or equivalent in joints not over 32" on center with one row of reinforcement placed in the block course running just above the top of the door.



LOCATION OF EMBEDDED JOINT REINFORCEMENT



CONCRETE MASONRY CONSTRUCTION DETAILS A.I.A. FILE 10-C

Additional details for
concrete masonry construction

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